KOLEJ UNIVERSITI KEJURUTERAAN DAN TEKNOLOGI MALAYSIA

BORANG PENGESAHAN STATUS TESIS

JUDUL : **BIOETHANOL PRODUCTION FROM EMPTY FRUIT BUNCH (EFB) OF OIL PALM**

SESI PENGAJIAN: **2006/2007**

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ABSTRACT

There are several methods to produce bioethanol. The bioethanol can be produced from cellulose and hemicelluloses that originate from many sources of biomass. The studies focused on the production of ethanol from oil palm waste using Saccaromyces cerevisie as fermentation aide to expand the usage of the oil palm waste. The purposes of this study were to determine the yield of ethanol produced from certain amount of biomass waste (oil palm wastes). Other than that the effects of different glucose concentration to the yield of bioethanol were studied. Besides, the effects of the different concentration of Saccaromyces cerevisae used to the yield of glucose production were studied too. Two sets of experiments were performed; in first set, the sample was hydrolyzed with pretreatment with sodium hydroxide then being subjected to sulfuric acid. The oil palm empty fruit bunch (EFB) is hydrolyzed using different concentrations of acid. Pretreatment is for break the lignin seal. At the second set the fermentation with Saccaromyces cerevisae was done in anaerobic condition. Different concentration of yeast was used in this experiment. The result showed that, the inoculums concentration did not have pronounced effect on the final ethanol concentration but the duration of fermentation decreased with the increase of the yeast concentration. It also showed that as the concentration of glucose increased, the ethanol concentration also increased where the highest final ethanol concentration with 15mg/ml of glucose was 13.8 % (w/w)

ABSTRAK

Pada masa kini terdapat pelbagai kaedah untuk menghasilkan ethanol. Antara kaedah yang digunakan adalah penghasilan ethanol menggunakan hemiselullosa dan selullosa daripada hasil buangan biojisim. Kajian terhadap penghasilan ethanol daripada hasil buangan pokok kelapa sawit menggunakan kaedah penapaian menggunakan yis, dilakukan untuk memperluaskan penggunaan bahan buangan pokok kelapa sawit tersebut. Tujuan kajian ini dilakukan adalah untuk menentukan ethanol yang terhasil daripada bahan buangan pokok kelapa sawit. Kesan kepekatan glukosa yang berbeza terhadap ethanol terhasil juga dikaji Selain itu juga, kesan menggunakan kepekatan yis yang berbeza dalam penghasilan ethanol juga turut dikaji. Di dalam kajian ini, hasil buangan yang digunakan adalah tandan kosong buah kelapa sawit (EFB). Dua set eksperimen telah dilakukan; untuk set yang pertama, sampel dihidrolisiskan melalui prarawatan menggunakan natrium hidroksida kemudian ditindakbalaskan dengan asid sulfurik. Proses hidrolisis yang dilakukan ke atas tandan kosong buah kelapa sawit (EFB) tersebut menggunakan kepekatan asid sulfurik yang berlainan. Prarawatan adalah untuk memecahkan lignin dalam struktur. Kemudian pada set kedua penapaian menggunakan yis Saccaromyces cerevisae dijalankan dalam keadaan anaerobik. Proses penapaian dilakukan menggunakan kepekatan yis yang berbeza. Pada akhir eksperimen, didapati kepekatan yis yang berbeza pada sample tidak memberi kesan pada kepekatan ethanol yang terhasil. Masa proses penapaian didapati berkurangan dengan bertambahnya kepekatan yis. Selain itu didapati dengan bertambahnya kepekatan glukosa, kepekatan ethanol terhasil juga bertambah. Kepekatan tertinggi ethanol didapati ialah 13.8 % (w/w) iaitu pada kepekatan glukosa 15mg/ml.

CHAPTER 1

INTRODUCTION

1.1 Background of Study

Ethanol or ethyl alcohol (C_2H_5OH) is a flammable, colorless liquid with a boiling point of 78.5° C. Its low melting point of -114.5° C allows it to be used in antifreeze products. Its density is 789 g/L, about 20% less than that of water [1]. It is biodegradable, low in toxicity and causes little environmental pollution if spill. Figure 1.1 shows the formula structure of ethanol where ethanol is the second member of the aliphatic alcohol series. The aliphatic alcohols are a series of homologous series organic compounds containing one or more hydroxyl groups [-OH] attached to an alkyl radical.

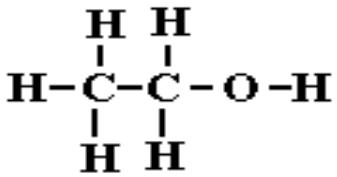

Figure 1.1: Formula Structure of Ethanol

Ethanol is one form of renewable energy that is becoming widely used, especially as fuel in automotive engine. Unlike gasoline, which is refined through distilling crude oil, ethanol can be synthesized from the starchy parts of plants. Microscopic yeast cells break down the starch and water, creating ethanol and carbon dioxide gas. Similar to gasoline, ethanol burns to produce carbon dioxide and water in complete combustion. It also a high octane fuel, subsequently has replaced lead as an octane enhancer in petrol.

Bioethanol is an ethanol synthesized from biomass and it is renewable. Therefore bioethanol has some advantages over petrol as fuel. As the biomass grows, it consumes as much carbon dioxide as it forms during the combustion of bioethanol, which makes the net contribution to the green house effect zero. By encouraging bioethanol's use, the rural economy would also receive a boost from growing the necessary crops. In addition, using bioethanol in older engines can help to reduce the amount of carbon monoxide produced by the vehicle thus improving air quality. Another advantage of bioethanol is the ease with which it can be easily integrated into the existing road transport fuel system. In quantities up to 5%, bioethanol can be blended with conventional fuel without the need of engine modifications [2].

Bioethanol is produced using familiar methods, such as fermentation, and it can be distributed using the same petrol forecourts and transportation systems as before.Two reactions are key to understanding how biomass is converted to bioethanol:

i. Hydrolysis is the chemical reaction that converts the complex polysaccharides in the raw feedstock to simple sugars. The feedstock must first be hydrolyzed into glucose molecules before ethanol production can begin [3]. In the biomass-to-bioethanol process, acids and enzymes are used to catalyze this reaction.

ii. Fermentation is a series of chemical reactions that convert sugars to ethanol. The fermentation reaction is caused by yeast or bacteria, which feed on the sugars. Ethanol and carbon dioxide are produced as the sugar is consumed. The simplified fermentation reaction for the 6-carbon sugar, glucose, is:

$$C_6H_{12}O_6 \rightarrow 2\ CH_3CH_2OH + 2\ CO_2$$

Glucose → ethanol + carbon dioxide (1.0)

The sugar formed in the hydrolysis reaction is fermented into bioethanol. The most common microorganism for this purpose is *Saccharomyces cerevisiae*, ordinary baking yeast [4]. Various species of *Saccharomyces* are examined for ethanol production processes because they are very efficient in converting sugars into ethanol [5]. Besides glucose, *Saccharomyces cerevisiae* has the ability to ferment manosse as well.

In this study empty fruit bunch (EFB) of oil palm has been chosen to be the substrate for the fermentation here in this research due to its abundant and low cost rather than using other source it also clean, a nontoxic and renewable.

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